NON-PUBLIC?: N
ACCESSION #: 9206150003
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Oconee Nuclear Station, Unit 1 PAGE: 1 OF 05

DOCKET NUMBER: 05000269

TITLE: Reactor Trip Results From Electrical Generator Lockout After Equipment Failure In A Generator Protective Relay Circuit
EVENT DATE: 05/07/92 LER #: 92-003-00 REPORT DATE: 06/08/92

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: N POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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Manager

COMPONENT FAILURE DESCRIPTION:
CAUSE: F SYSTEM: TL COMPONENT: CON MANUFACTURER: G080
F BJ V C568
F BJ XIS C753
REPORTABLE NPRDS: Yes
Yes
Yes

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On May 7, 1992, at 1355 hours, Unit 1 reactor tripped from 100 percent full power on a Reactor Protective System turbine anticipatory trip signal due to a generator lockout. The lockout occurred when a protective relay circuit (41MXa) spuriously actuated. An investigation found that the control power to the relay circuitry was interrupted due to a loose connector pin. The root cause of the event was equipment failure in the 41MXa circuitry. Post-trip operator response stabilized the plant. Corrective action was to bypass the defective pin connector and hard wire to the appropriate terminal.

END OF ABSTRACT

BACKGROUND

The electrical generator EIIS:GEN! uses protective relaying to sense abnormal conditions which may adversely affect the generator. When such a condition is sensed, it produces a lockout which will open the main generator breakers EIIS:BRK!, Power Circuit Breakers (PCB)-20 and -21, and trip the turbine. One of the protective circuits used to produce these actions is the relay circuit associated with the 41MXa relay EIIS:RLY!. This relay senses the position of the main generator field breaker. The relay fails in a position which indicates an open Main Generator Field Breaker. When the relay fails, it's contacts 3R and 3Ra open tripping the 86GA lockout relay. If it is actuated while PCBs -20 and -21 are closed, the (86GA) lockout relay will actuate and a generator lockout will occur. Some of the wire terminals for this circuitry are mounted to the generator exciter housing. This housing is physically removed during some refueling outages. To facilitate its removal, the incoming and outgoing wires are fitted with electrical plug connectors (twist-to-lock type).

A turbine trip will produce a reactor trip when power is greater than 30 percent power by actuating Reactor Protective System EIIS:JC! turbine anticipatory trip channels. The purpose of this trip is to limit Reactor Coolant System EIIS:AB! pressure and prevent challenging the Power Operated Relief Valve.

EVENT DESCRIPTION

On May 7, 1992, Unit 1 was operating at 100 percent full power. At 1355:06 hours an electrical generator lockout occurred. Immediately following this lockout the main turbine tripped. Since reactor power was greater than 30 percent, a Reactor Protective System (RPS) anticipatory signal tripped the reactor.

All full length control rods EIIS:ROD! fully inserted into the core and the reactor was shutdown. All five power range detectors decreased normally following the trip.

Following the reactor trip the average Reactor Coolant System (RCS) temperature decreased from 578 degrees F to 555 degrees F and the RCS pressure decreased from 2137 psig to 1820 psig. Pressurizer EIIS:VSL! level decreased from 233 inches to a minimum of 68.7 inches. Steam Generator (SG) 'A' pressure increased to a momentary (less than one

second) peak of 1127 psig and decreased to a minimum of 995 psig. SG 'B' pressure increased to a maximum of 1105 psig and decreased to a minimum of 965 psig. The SG levels decreased to a minimum of 22 inches on SG 'A' and 21 inches on SG 'B'. RCS pressure slowly increased to 2142 psig. Pressurizer level increased and stabilized at 130 inches. SG pressures increased and stabilized at approximately 1004 psig. SG levels increased and were maintained at the 25 inch post-trip setpoint. These parameter values occurred within 15 minutes following the trip.

The Instrument and Electrical (I and E) Power Delivery personnel investigated the cause of the generator lockout. They found that relay 41MXa, which senses the main generator field breaker closure, had actuated

but that the main field breaker had not opened. They also found the main generator lockout relay, 86GA, had actuated. Further investigation found that a loose pin connection on pin number six of the Turbine Supervisory Control's EHC plug connector caused the interruption of control power and deenergized the 41MXa relay.

During this event three minor occurrences took place. The first involved the 1B Feedwater Pump Turbine contact buffer in the 1D Reactor Protection System channel not resetting as expected. The I and E investigation indicated that the contact buffer was not the problem, but the feedwater pressure switch, 1PS-419, was out of calibration. The second involved feedwater valve, 1FDW-50 (1A Feedwater Suction Relief Valve), failing to reseat properly after lifting. The mechanical maintenance investigation indicated that some debris was trapped between the valve's disc and seat.

The third involved stator coolant leakage at the top of the insulating tubes in the generator field rectifier cabinets. The I and E investigation indicated that this occurred due to the cooldown of the components after the generator trip. The insulating tubes are made of a teflon like material which are sensitive to temperature changes.

CONCLUSIONS

The root cause of this event is equipment failure. A loose pin connection, on pin number 6 of the Turbine Supervisory Control's plug, caused a loss of control power to the 41MXa relay. Induced vibration to the loose pin connector caused a spurious actuation of the relay. Circuit continuity existed when the relay was initially energized during a startup in October 1991. This implies that vibration caused the loose pin connector to move to positions which created an intermittent open

control power circuit. When the relay's control power was intermittently disrupted it sent multiple false signals that the generator main field breaker was open. One of those false signals caused the Generator Lockout Relay (86GA) to actuate and effect the generator lockout.

A review of past events showed that a similar trip occurred on Unit 1 on December 2, 1984. A wire was found to be loose within the connector plug. The Exciter cabinet had been removed during the previous refueling outage. The unit had been placed on line on November 29, 1984 and had experienced high vibration at the exciter-generator coupling. The corrective action for the 1984 event was to tighten the wire to the connector and to inspect similar connections on Units 2 and 3. Also, on October 2, 1991, a Unit 1 trip occurred due to a generator lockout caused by either a loose Turbine Supervisory Control EHC connector plug or loose connections on the E
terminal block. The corrective action for the 1991
event included tightening the loose terminal connections and plug connectors. Also, the planned corrective actions for that event included (1) inspecting of terminals and connectors in high vibration areas, determining if a preventive maintenance program is needed to periodically inspect these components, (2) conducting an engineering evaluation of the 41MXa failure logic, and (3) writing a procedure to tighten and lock-wire all connectors and tighten all terminal connections in the EH cabinet. Due to the event on October 1991 this is classified as a recurring problem.

The planned corrective actions numbers one and two for the October 2, 1991 event appear to be adequate to help prevent recurrence of this problem, but have not been completed to date. Planned corrective action number one states that Instrument and Electrical personnel will inspect and correct as necessary terminals and connectors located on equipment subject to high vibration. It also states that based on these inspections, an evaluation will be made to determine whether a preventive maintenance program to inspect these terminals on a periodic basis is required. For this event it was determined that a loose pin connector within the plug connector was the initiating cause. The previous planned corrective action should evaluate the integrity of all subject connectors and replace them if necessary. The use of star or lock washers on terminal blocks to prevent loosening in high vibration areas will also be included in this evaluation. Planned corrective action number 2, from the previous event, states that Engineering will evaluate the failure logic of relay 41MXa to determine if alternate logic schemes are needed. Engineering is working on a modification which will wire the Generator Lockout circuitry directly to the Generator Main Field Breaker to provide

a true indication of the breaker's position. This should eliminate any further false indications of the breaker's position as generated by relay 41MXa after it lost it's DC control power. This modification will be performed under Exempt Change 4736. No further corrective action should be needed to prevent recurrence of this problem.

The cause of the loose pin connector in the plug is attributed to either an inferior quality plug and/or repetitive connecting and disconnecting. The problem with the loose pin connector was resolved prior to unit startup by jumpering the wire (EHC-6) around the plug connector and hard wiring it to the EH terminal block.

The problem with the 1B Feedwater Pump Contact Buffer in the Reactor Protection System Channel 1D was corrected under work request number 37315C. No problem could be found with the contact buffer itself, but pressure switch, 1PS 419, was found to be out of calibration and the cause for the contact buffer not resetting properly. After the pressure switch was calibrated the contact buffer was tested and found to reset properly.

The problem with 1FDW-50 was corrected under work request number 37318C by replacing it with a new valve. The valve did not seat completely because of debris trapped between the disc and the seat. The old valve was removed, refurbished, tested, found to function properly, and placed back in stock.
The problem with the stator coolant leaks in the Generator Field Rectifier cabinets due to the insulator tubes leaking was corrected by tightening the securing nuts located on the top of each tube. No leaks were observed prior to startup.

Response of the primary system to the trip was normal. Reactor Coolant System (RCS) inventory, RCS pressure, and RCS temperature were all maintained within the normal post-trip range. The immediate response of the secondary system was also normal. Both steam generator pressure and level were maintained at or near their proper setpoint.

NPRDS reportable equipment failures for this event include: General Electric Alterex, model ATI (EH connector plug); Consolidated Valve

Corporation, model 1997C (1FDW-50); and, Custom Control Sensors, model 646 GEM5 (1PS-419). The event did not involve radioactive releases, overexposure to radiation, or personnel injuries.

CORRECTIVE ACTIONS

Immediate

1. Operations personnel safely controlled the reactor after the trip.

2. An immediate investigation was initiated to determine the cause of the reactor trip.

Subsequent

1. The loose connector pin was bypassed and its wire hard wired to the EH terminal block.

2. Valve 1FDW-50 was replaced.

3. Pressure switch was calibrated and the 1B Feedwater Pump Contact Buffer in the Reactor Protection System Channel 1D was tested and found to be acceptable.

4. The stator coolant leaks in the Generator Field Rectifier cabinet were stopped by tightening the insulating tubes.

Planned

None

SAFETY ANALYSIS

A generator lockout and the resulting turbine trip, while at power operation, leads to an imbalance between the amount of power produced in the primary system and the amount of power removed by the secondary system. This results in Reactor Coolant System (RCS) heatup and pressurization and an eventual challenge to the Power Operated Relief Valve. The Reactor Protective System prevents excessive RCS overpressurization and heatup by use of the turbine anticipatory reactor trip. That is, the turbine trip will cause a reactor trip in anticipation of increased RCS pressure. This safety feature successfully actuated during this event. The health and safety of the public was not compromised by this event.

ATTACHMENT 1 TO 9206150003 PAGE 1 OF 1

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DUKE POWER

June 8, 1992

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Subject: Oconee Nuclear Site
Docket Nos. 50-269, -270, -287
LER 269/92-03

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report (LER) 269/92-03, concerning a reactor trip.

This report is being submitted in accordance with 10 CFR 50.73 (a)(2)(iv). This event is considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

J. W. Hampton
Vice President

/ftr

Attachment

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